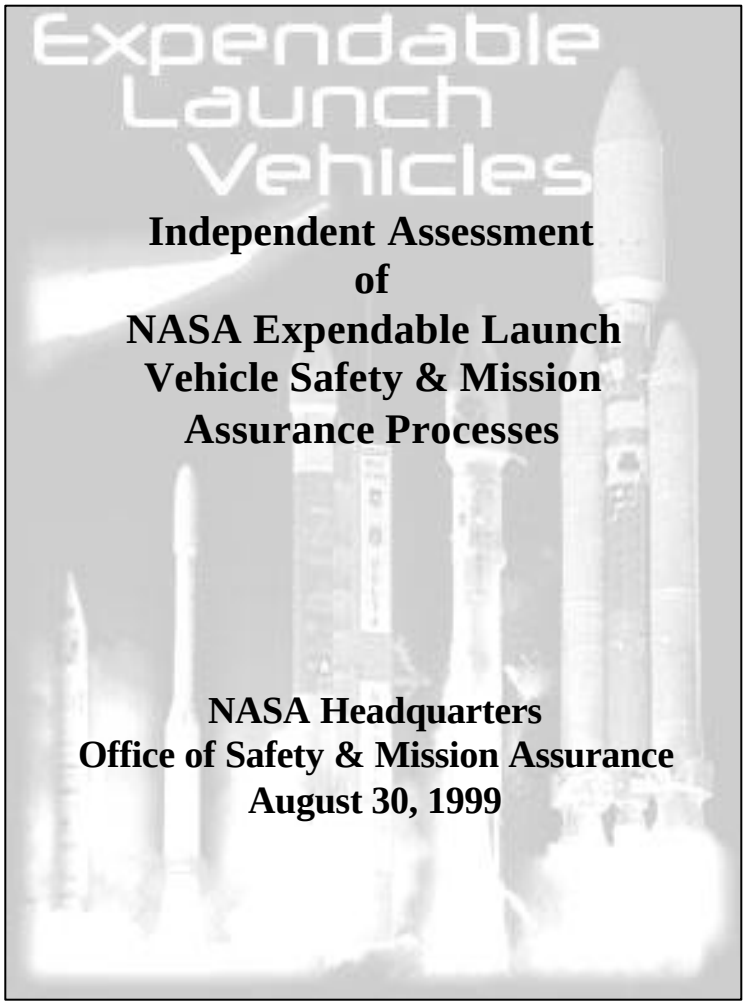
This document contains excerpts from the Expendable Launch Vehicles (ELV) Independent Assessment Report (title page shown below). Only those sections which relate to the PBMA element **Concept Development** are displayed.

The complete report is available through the PBMA web site, Program Profile tab.



1.2 ELV Background and Mission Model

1.2.1 Congressional Branch – Legislative History

The Commercial Space Launch Act (CLSA) of 1984 was established by Congress to create a framework within which ELV's, launch facilities, and commercial launch operations could be licensed. The primary purposes of the act are:

- Foster economic growth and entrepreneurial activity through the use of space for peaceful purposes
- Encourage the development of a private U.S. launch vehicle industry by simplifying and expediting the issuance of necessary licenses and facilitating the commercial use of government-developed space technology
- Designate the Department of Transportation to oversee, regulate, and license commercial launch operations.

An amendment to the Commercial Space Launch Act, November 1988 clarified commercial launch liability, launch preemption, and direct costs. In addition, the NASA Authorization Act of 1988 authorized the NASA Administrator to limit ELV contracts to U.S. sources.

The Launch Services Purchase Act of November 1990 directed NASA to procure commercially available U.S. expendable launch services and limited the use of the Shuttle for satellite delivery to those missions requiring the Shuttle's unique capabilities, i.e., crew support. The effect of this Act was to require procurement of launch service-to-orbit delivery with limited government insight and limited cost and pricing data.

The Commercial Space Competitiveness Act of November 1992 encouraged the continued use of commercial services/practices and required a NASA launch voucher demonstration program.

The amendment to the Commercial Space Launch Act of January 27, 1998 addressed the addition of "reentry" vehicles and operations, the use of space transportation services from U.S. commercial providers, and compliance with applicable safety standards. This amendment also established that space transportation services would be considered to be commercial items, i.e., a shift away from FAR Part 15 procurement and towards FAR Part 12 procurement requirements. This aspect of the CSLA is discussed in greater detail in appendix A, section A.2.

1.2.2 Executive Branch - National ELV Policies

The National Security Decision Directive (NSDD) 94 of May 1983 established ELV commercialization policy. NSDD 254 of December 1986 established a mixed fleet launch policy for government missions and directed NASA to procure ELV launch services.

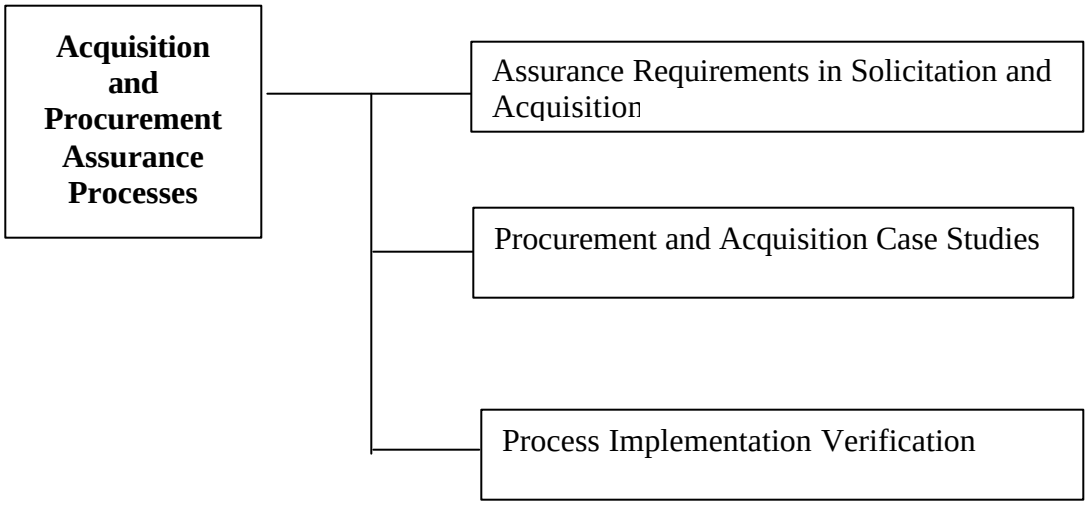
National Space Transportation Policy of February 1988 and November 1989 reaffirmed and clarified NSDD 94 and also stated that NASA was to procure launch services directly from the private sector or the Department of Defense (DoD). The National Space Transportation Policy of 1994 stated that the DoD was to lead the improvement/evolution of the current ELV fleet while NASA was to develop the next generation of reusable launch vehicles.

Commercial Space Launch Policy of 1990 stated that U.S. government satellites were to be launched on U.S. ELV's unless exempted by the President. Additional guidelines adopted in 1991 stated that U.S. government agencies were to utilize commercially available space products and services. This policy also stated that the primary transport would be a mixed fleet of the Space Transportation System and ELV's through the 1990's. Additionally, the U.S. government was to maintain and improve the existing ELV fleet.

A.2 Acquisition and Procurement Assurance Processes

Introduction

Key acquisition and procurement processes include the Source Evaluation Board (SEB) activities in which necessary assurance provisions are included in the contract notwithstanding the barriers imposed by changing legislative direction. The SEB has the power to establish the assurance requirements as described below:



If a contractor is selected who has proposed to implement demonstrated and capable assurance processes, the pre-award audit serves to verify process implementation and capability. Subsequent periodic audit of contractors will serve to validate, on an ongoing basis, the implementation of critical assurance processes. Finally, the assignment of payloads to launch vehicle based on demonstrated performance represents yet another assurance process.

Background

Commercial Space Launch Act Amendment of January 1998 - Under the provisions of the FAR Part 12 procurement, launch services must now be procured as commercial items. This mandates that the government must accept those processes and documentation that are customarily provided by or are consistent with accepted commercial launch service industry practices. Thus, this procurement approach limits the government's insight into the launch service provider's design and development processes and restricts the ability to set forth or impose specific mission assurance requirements. Any mission assurance oversight or approval requirements that the government might wish to impose, and that are not consistent with said commercial practices, require a specific waiver and supporting justification.

FAR Part 12 limits the detail and amount of pricing data available to the government because this information is associated with the company's competitive position relative to current and future contracts and is, thus, considered to be proprietary in nature. The pending NASA Launch Service (NLS) contract will be the first launch service procurement using FAR Part 12.

All current commercial launch service contracts incorporate FAR Part 15 procurement requirements. Under FAR Part 15 the government has the authority and, indeed, the responsibility to impose any and all requirements (processes, practices, documentation, etc.) it deems necessary to assure success for its missions.

Existing KSC ELV Launch Service Contracts - NAS5-30722 with McDonnell Douglas (Boeing Corporation) for Medium Class ELV's (MELVS) was previously managed at GSFC. This contract was awarded on November 14, 1990, with three firm missions and 12 options. All of those options have been exercised with a modification to exercise the last two options for Mars '01 Orbiter mission and the SIRTF mission. This modification was executed on September 30, 1998. The total estimated price of the contract at this time is $775M. There are no remaining options after execution of the contract modification.

NAS5-32933 with McDonnell Douglas (Boeing Corporation) for Med-Lite (Medium-Lite) ELV's was previously managed at GSFC. This contract was awarded on February 27, 1996, with five firm missions and nine options. Four of those options have been exercised with five remaining. The total estimated price of the contract at this time is $367M. There are planned missions on the manifest to cover options through 2002.

NAS5-32836 with Orbital Sciences Corporation for UELV's was previously managed at GSFC. This contract was awarded on December 23, 1994, with two firm missions and eight options. One of those options was exercised (CLIN #3). This mission was for HETE-11/ACRIM that was scheduled for October 1999. However, a stop-work order was issued in September 1998, for CLIN #3 to move ACRIM to another launch vehicle. The total estimated price of the contract at this time is $24M. The last date for exercising the remaining options is December 22, 1999.

NAS3-27262 with Lockheed Martin for IELV launch services was previously managed at GRC. This contract was awarded in December 1994. One firm mission and eight options (TDRS-H/I/J) have been exercised to date. There are five remaining options that can be exercised through December 2000. The total contract value to date is $400M.

NAS3-23440 with Lockheed Martin for GOES was previously managed by GRC. This contract was awarded May 20, 1988. It encompassed the GOES I-M launches. The contract had three firm missions with two options. Both options (GOES L and M) were exercised. The launches are planned for FY 1999 and FY 2001, respectively. The total price of the contract at this time is $375M.

Contract NAS10-99005 with Orbital Sciences Corporation and NAS10-99010 with Coleman Aerospace were awarded in October 1998: This procurement and the resulting contracts are being managed by KSC. The launch service being procured is a multiple award, indefinite deliver/indefinite quantity (ID/IQ) contract that will support up to 16 launch services with an ordering period of 5 years.

Future KSC ELV Launch Service Contracts - The NASA Launch Services (NLS) contract is in the procurement stage. The draft Statement of Work (SOW) was released in March 1999, and a draft RFP was released in April 1999. The proposed contract represents NASA's requirements for domestic launch services with a minimum performance capability of placing a 1,500-kilogram spacecraft in a 200-kilometer orbit at an inclination of 28.5 degrees. This procurement will seek to adopt the best commercial practices and customs while ensuring Agency mission needs are satisfied via safe and reliable access to space. The procurement envisions a multiple year period of performance beginning at contract award tentatively scheduled for fourth quarter CY 1999.

Assurance Requirements in Solicitation and Acquisition

NASA Management Instruction (NMI) 8610.23 establishes "Technical Oversight of Expendable Launch Vehicle Services." Oversight, as defined in NMI 8610.23, means government approval and insight. NASA's program approval refers to providing the launch service contractor authority to proceed and/or formal acceptance of requirements, plans, tests, or success criteria in specified areas. NASA's program insight refers to the Agency gaining an understanding necessary to concur/nonconcur with contractor actions through watchful observation, documentation, meeting attendance, reviews, tests, and compliance evaluations. The NMI applies to NASA Headquarters and all NASA Centers, and affects all ELV service contracts. NASA program launches established through grants are not subject to Agency technical oversight.

NMI 8610.23 requires that when NASA acquires launch services, its solicitations and contracts will:

- Include the government's approval and insight requirements
- Permit independent verification/validation by NASA of selected critical mission analyses, processes, tests, and acceptance criteria to maximize probability of launch success
- Permit approval by NASA of all mission-unique analyses, spacecraft to launch vehicle interfaces, design, and test procedures
- Permit substantial involvement in, control of, and final approval by NASA of the go-for-launch
- Protect public health, safety, and property; adhere to national environmental guidelines; and preserve national security and foreign policy interests attendant with a government launch.

Procurement and Acquisition Case Studies

The NASA Launch Services (NLS) Procurement - The NLS contract is currently in the initial procurement stage. Under the provisions of the Commercial Space Launch Act - Amendment of January 1998, launch services are now to be procured as commercial items. This falls under FAR Part 12. During initial NLS acquisition meetings, it was determined that additional requirements were needed by NASA to assure an acceptable level of mission risk and to fulfill NASA assurance responsibilities.

FAR Part 12 allows waivers to permit specification of assurance requirements beyond those normally applied for basic commercial items. Waivers were requested by KSC and approved by NASA Headquarters in following areas:

- Inspection acceptance clause (addition of NMI 8610.7, NMI 8610.23, and NMI 8610.24 as requirements to the commercial procurement)
- Changes clause (addition of requirements that the government retains the ability to direct changes)
- Payment clause (addition of requirements that payments will be made based on progress/performance versus specified time periods).
- Insight (addition of requirements that NASA will have insight)

In addition, the NLS contract required ISO 9001 certification and plans for system safety and health, reliability, quality assurance, parts control, materials control, processes control, contamination control, electro-static discharge control, configuration management, and software control.

Acquisition Case Study – NASA Oversight: FUSE/Delta 7320 - The FUSE/Delta 7320 launch vehicle was acquired under the Med-Lite Launch Services Program, contract number NAS5-32933. In accordance with the Med-Lite SOW and related documentation requirements, Boeing has established a Performance Assurance Program as set forth in the Program Assurance Implementation Plan (PAIP). NASA requirements documents NHB 5300.4 (1A1) and NHB1700.1 (VI-B) and ANSI/ASQC Q9001 were used as overall guidance in the development of the Performance Assurance Program and PAIP. The objective of the PAIP is to ensure a high probability of mission success through the design, production, and operation of a safe, reliable, and high quality launch system. This objective will be accomplished through the following:

- Establishment of effective performance assurance management systems, policies, and controls
- Implementation and verification, through inspection and test, of safety and reliability design features
- Conduct of oversight analysis, inspection, and test verifications to ensure vehicle compliance with the intended design
- Flow down of performance assurance requirements consistent with system level requirements to subcontractors and implementation of vendor controls

- Conduct of periodic reviews and audits to verify that performance assurance requirements are being met.

The PAIP (as well as the System Effectiveness Plan) contain sections which address the following assurance areas:

- System Safety and Health
- Reliability
- Quality Assurance
- Parts, Materials, and Processes
- Contamination Control
- Electrostatic Discharge Control
- Configuration Management
- Software

Government monitoring of launch services provided by the private sector has two elements, approval and insight. Government approval is defined as providing authority to proceed and/or formal acceptance of requirements, plans, designs, analyses, tests, or success criteria in specified areas. Government insight is defined as gaining understanding necessary to knowledgeably concur with the contractor's action through watchful observation, inspection, or review of program events, documents, meetings, tests, audits, hardware, etc., without approval/disapproval authority. NASA has approval authority for activities related to spacecraft integration and mission analyses, integrated spacecraft/vehicle prelaunch operations, launch countdown procedures and launch go/no go decision. Insight responsibilities apply to launch vehicle system design, development, and production, vehicle integrated systems tests, launch site vehicle assembly and test, and post flight analysis. Specific approval and insight responsibilities for the FUSE/Delta II mission are delineated in the Med-Lite contract, Section H.3, and the PAIP.

Acquisition Case Study – Limited Oversight: QuikSCAT-Titan II (G7) - The case of Titan II and Principal Investigator (PI) acquisitions (acquisition in this case means providing NASA resources to acquire an ELV launch) is important to consider. It is not clear what NASA policy directives apply. There is no documented process which describes Memorandum of Agreement (MOA) interfaces, coordination, or the specification of assurance requirements for ELV's when provided by the Department of Defense.

The QuikSCAT-Titan II (G7) mission MOA with the U.S. Air Force, does not explicitly address SMA requirements. The MOA notes that NASA has mission success responsibilities but indicates that neither the USAF nor NASA will independently review or assess each other's hardware or software. NASA is therefore entirely dependent upon the USAF which has ultimate responsibility for launch vehicle systems. NASA has responsibilities for defining the overall mission requirements. The MOA was developed by the OSF. Signature blocks are provided only for the Associate Administrator for Space Flight and an Assistant Secretary of the USAF. The MOA did not involve any members of the NASA SMA community. The MOA did involve the NASA General Counsel late in development. Five days prior to launch, the MOA had not been signed by all parties.

Core vehicle assurance requirements were contained in existing contracts between the USAF and Lockheed-Martian Astronautics (LMA). Additional quality assurance requirements were contained in the USAF Letter of Delegation (LOD) to the Defense Logistics Agency (DLA) through an MOA. Spacecraft assurance requirements were defined in a GSFC LOD to the DLA resident at the Ball Aerospace facility in Boulder, Colorado. Range safety requirements are contained in Eastern Western Range (EWR)-127-1.

The USAF is responsible for implementing all launch vehicle assurance activities through their relationships with LMA, Aerospace Corporation, DLA, and the Vandenberg Air Force Base commander. GSFC is responsible for implementing assurance activities on the spacecraft through their relationships with DLA and Ball Aerospace.

NASA provided $2.4M in assurance support to the USAF to pay for Aerospace Corporation support. There was no NASA independent validation of LMA analyses although there was significant Aerospace Corporation independent validation activity in many areas including software, mission planning (trajectory), and coupled loads. NASA did review all LMA and Aerospace Corporation analyses.

The MOA language serves to minimize or limit NASA involvement in performing independent verification or validation of contractor mission critical engineering, test, or assurance activities. The MOA language paragraph 6 states, in part:

> *"None of these principles (embodied in the MOA) shall be construed as giving NASA basic responsibilities for the launch vehicle system …these remain with the Air Force."*
>
> *"…Both parties will assure that their participation is non-intrusive and in the spirit of acting as an informed partner. It is not intended or planned that NASA or the Air Force will perform an independent assessment of the other party's hardware/software."*

Individuals interviewed described the NASA insight as "arms length," "minimal coverage," and "restricted." Access of NASA SMA and engineering personnel to the vehicle on the pad was indeed restricted

<u>Process Implementation Verification</u>

A fundamental NASA mission assurance need is to verify that assurance activities defined in planning documents have indeed been implemented. Knowledge and understanding are derived from oversight (approval), insight (observation), witnessing, reviewing documentation and data, attendance at briefings and reviews, and independent analysis. Access to hardware, launch facilities, and documentation is required to perform effective verification and validation. Assurance processes are typically incorporated into the Systems Effectiveness Plans (SEP's) or equivalent documents as required by NMI 8610.23. The Boeing Product Assurance Implementation Plan (PAIP) serves as the key assurance document for the Med-Lite contract.

Future Contracts without SEP's - ELV contract assurance provisions are moving away from the SEP/PAIP approach toward ISO 9001 certification, providing confidence that a minimum, baseline quality management system is in place. NASA then imposes additional requirements above and beyond ISO 9001. Project Surveillance Plans will specifically delineate who has approval and insight responsibility for NASA requirements.